DISPLAY SYSTEM COVER

The present invention relates to an assembly for covering a visual display system which improves the optical and physical performance of the system.

It is known to provide visual displays made up of an array of pixels, with each pixel being created by a light source such as an LED or the end face of an optical fibre. Such visual displays can be used for informational signage, advertising, relaying TV pictures, art installations and so on. However, such displays suffer from a number of disadvantages. The angle at which the screen can be viewed and the distance from which it can be viewed in order to see a reasonably coherent and legible image are relatively limited. The optical performance and legibility even when viewed within the preferred ranges is not particularly great since the image tends to appear as dots of colour on a black background. The visual displays require additional modification, at great expense, in order to make them weatherproof for use outdoors and such systems have limited loadbearing capacities and cannot be used as structural members.

It is also known to use an array of CRT, plasma or LCD screens covered by thick glass sheets produce a large display. However, the size is still limited and the overall image produced is disrupted by the relatively thick edges to the individual TV screens.

The present invention provides an assembly for covering a visual display means which has an array of pixels, the

assembly comprising an array of cells with reflective walls and an opening at each end, and a transparent cover sheet adjacent the open end of the cells on one side of the array, wherein the array is dimensioned such that in use each cell is aligned with one pixel of the visual display means.

Preferably, the cells are contiguous and may be in the form of open ended tubes. In a preferred embodiment, the cells are formed from a honeycomb mesh of adjacent hexagonal cells. Alternatively, the cells may be formed by a mesh with substantially square apertures. In a further alternative, each cell may comprise a parabolic reflector with an opening in the centre of the base for alignment with a pixel of the visual display means. In a further alternative, each cell may comprise a light guide.

The walls of the cells may be provided with a surface treatment to increase reflectivity.

Additionally, a lens may be provided in each cell to capture substantially all of the light from the pixel.

The cover sheet preferably comprises glass or plastic. The assembly may also comprise a bottom sheet to create a load bearing structure and may also provide a weather proofing capability to protect the visual display means.

To improve the optical performance, the cover sheet may be moulded to form a lens aligned with each cell of the array. The cover sheet may also have a surface treatment applied to improve the optical characteristics.

Further option to improve the optical performance is to include lens means between the array of cells and the cover sheet, aligned with the walls of the cells, to allow diffusion of light between adjacent cells. The lens means may be in the form of adhesive used between the cells and the cover sheet.

The present invention also provides a visual display system comprising an assembly as described above secured to a visual display means having an array of pixels, such that the array of cells is sandwiched between the cover sheet and the visual display means.

In another aspect, the present invention provides a digital visual display system comprising a plurality of discrete light sources arranged in a plurality of rows, wherein the light sources in each row are offset with respect to the light sources in each adjacent row.

The invention will now be described in detail, by way of example only, with reference to the accompanying drawings in which:

Figure 1 is a schematic cross sectional view of part of a first embodiment of the present invention in combination with a visual display means, along the line A-A in Figure 2;

Figure 2 is a schematic plan view of part of the first embodiment shown in Figure 1;

Figure 3 is a schematic plan view of part of a second embodiment of the present invention;

Figure 4 is a schematic plan view of part of a third embodiment of the present invention;

Figure 5 is a schematic plan view of part of a fifth embodiment of the present invention;

Figure 6 is a schematic cross sectional view through part of a fifth embodiment of the present invention; and

Figure 7 is a schematic cross sectional view of a further feature of the invention, applicable to all of the embodiments.

Figure 1 is a cross section through a first embodiment of the present invention in combination with a visual display means. The visual display means 10 is of the dot-matrix (or digital) type, that is it comprises an array of pixels 12 each of which is formed by a light source such as an LED or the end of an optical fibre. The pixels 12 are mounted on a backing element 14 as is well known in the art.

The assembly 16 of the present invention comprises an array of cells 18 adjacent a transparent cover sheet 20. The walls 22 of the cells 18 are formed by a honeycomb mesh creating contiguous hexagonal cells as best seen in the plan view of Figure 2. The cells 18 are thus open at each end. The honeycomb mesh is typically formed of a material such as aluminium, thus making the walls 22 of the cells 18 reflective.

The array of cells 18 is dimensioned so that the assembly can be fitted over the visual display means 10 with each pixel 12 aligned with the centre of one cell 18. Thus, light from each pixel 12 passes through a cell 18 and can be observed through the transparent top sheet 20 by an observer 24. Reflection from the walls 22 of the cells 18 helps to optimise the amount of light transmitted through the cells 18, thereby enhancing the brightness of the image seen by the observer 24. The walls 22 may have a surface treatment to improve their reflectivity. Additionally, lenses (not shown) may be incorporated into each cell 18 to capture substantially all of the light from each pixel 12.

Employing the assembly 16 of the present invention in combination with a visual display means 10 provides a number of benefits. First, in terms of optical performance, internal reflection within each cell 18 means that the cells 18 are flooded with light. This in turn means the image seen by the observer 24 comprises blocks of solid colour rather than dots of colour on a black background.

In addition, the viewing angle and viewing distance ranges are increased. Thus, an observer may view the display from a greater range of angles and from a greater range of distances and still see a coherent and legible image.

A further advantage is that the top sheet 20 may be designed to provide structural performance, when combined with a bottom perforated sheet, to the whole display unit, i.e. it may be a load bearing element, allowing the unit to be used to create or form part of a floor or wall structure.

The top sheet 20 may also provide a weatherproofing function, allowing the display system to be used externally without further modification to the visual display means 10 itself.

The top sheet 20 may also be adapted to further enhance the optical performance by means of surface treatments and/or it may be moulded to form lenses (not shown) aligned with each cell 18 of the array to improve the light output.

The cells 18 need not be hexagonal cells of a honeycomb structure as illustrated in Figures 1 and 2. The cells 18 may instead be formed of cylindrical tubes 26, packed together as illustrated in Figure 3. Alternatively, a mesh 28 with substantially square apertures could be used as shown in Figure 4. Another arrangement is an array of equilateral triangles as seen in Figure 5. Another option is for each cell 18 to be in the form of a parabolic reflector as seen in Figure 6, having an opening in the centre of the base of each parabola to receive the pixel 12.

In some circumstances it is desirable to have some diffusion of light between adjacent pixels. This enables the improved rendering of images which have smooth edged forms or soft colour graduations. In order to allow for some diffusion between adjacent pixels, one option is to provide a form of lens (30) on the top of the walls 22 of the cells 18, extending between the walls 22 and the cover sheet 20. This is illustrated in Figure 7. This network of lenses may be created as a separate part to be included in the assembly or may be formed by using a liquid adhesive,

which sets into a light transmitting bead between the cells 18 and the cover sheet 20. This arrangement may be incorporated in any of the embodiments described.

A further possibility is to form each cell 18 as a light guide such as a solid glass or plastic element with a plane face at each end, which allows substantially all the incident light to pass through without reflection, constituting the "open ends" of the cell. The side walls of the light guide which join these end faces, however, provide for substantially total internal reflection so that all the light entering the light guide is transmitted through it and out of the opposing end face.

It will be apparent from these examples of cells 18 are not exhaustive and other possibilities exist.

As described above, the arrangement of pixels 12 and the shape and arrangement of the overlying cells 18 can take a variety of forms. In particular, the pixels 12 may be arranged in a square grid as shown in Figures 4 and 5 in which the pixels are in rows with the pixels in each row being aligned with the pixels in each adjacent row. Alternatively, the pixels 12 may be in an offset arrangement with the pixels in each row being offset with respect to the pixels in each adjacent row as in Figures 2 and 3. In some applications, this offset arrangement is preferred since each pixel 12 has a greater number of equidistant neighbouring pixels 12. In the arrangements of Figures 2 and 3, each pixel 12 will be equidistant from 6 neighbouring pixels 12. However, with the arrangement of Figures 4 and 5 each pixel has only four equidistant neighbours closest to

it. The offset arrangement, with each pixel having a greater number of equidistant neighbours, allows improved mapping of images onto the display and this results in images of better effective resolution to the observer.

Thus, the present invention makes it possible to provide large visual display systems with excellent optical performance which are useable both internally and externally and are capable of bearing loads and forming structural members. It will be apparent that a number of variations and modifications to the precise details described herein are possible, without departing from the scope of the invention are set out in the claims.